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A GENERALIZED REAL-TIME EXECUTIVE ROUTINE FOR THE UNIVAC 1230 C--ETC(U)

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NAVY UNDERWATER SOUND LABORATORY
NEW LONDON, CONNECTICUT

6 A GENERALIZED REAL-TIME EXECUTIVE ROUTINE
FOR THE UNIVAC 1230 COMPUTER.

by

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NUSL Technical Memorandum No. 2211-63-70

11 31 March 1970

DDC
OCT 23 1978

9 Technical memo.

INTRODUCTION

Use of a computer to perform repetitive real-time tasks such as equipment control, monitoring, data gathering and data reduction requires an executive routine which will ensure that the proper actions are initiated at the appropriate times.

This memorandum describes GPEXEC1, a generalized real-time executive routine for the Univac 1230 computer. Written in assembly language, it can be assembled by and run on other Univac computers which are similar to the 1230.

Included is a flow chart, a sample timing chart, a program listing and a timing test routine.

GENERAL DESCRIPTION

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GPEXEC1 is a program which calls on a sequence of routines in a predetermined order. The time at which each routine in the sequence is called is determined by preset table entries and the computer's real-time clock.

THE REAL-TIME CLOCK

The real-time clock is, for programming purposes, a memory cell whose contents are increased by one every 1024th of a second. Since the clock will overflow into the sign bit and turn negative after approximately six days, it is necessary to reset it periodically. Therefore, a check on the clock is made prior to the execution of each

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routine. If a reset is necessary, a flag is set and the clock is cleared following the execution of the upcoming routine.

CAPABILITIES OF GPEXEC1

GPEXEC1 is capable of repeatedly executing a sequence of N routines in a specified order. The time of execution for each routine, relative to the start time of the exec, is specified by the user. Also specified by the user is REPTIME, the time interval between successive executions of the sequence of routines.

It is assumed that each routine will be completed before it is time to execute the next. However, should a routine fail to return control to the exec prior to the execution time of the next, the next routine will be executed immediately upon return of control. The manner in which the timing is handled will ignore this tardiness and the routine will be scheduled for its next execution at the proper time.

The time of execution of any routine may be varied relative to the preceding and following routines. Also, the entire sequence may be easily shifted forward or backward in time.

GPEXECL can be set up so that one or more routines are executed only occasionally. A routine can also be deleted entirely from the sequence of events. These capabilities will be discussed in detail later in this memorandum.

SETTING UP GPEXEC1 FOR A SPECIFIC TASK

To set up GPEXEC1 for a specific task, it is necessary to supply entries to two tables and to set two parameters.

The first parameter is the number punched on the card labeled EXEC 05 (see program listing). N should be set to the number of routines which the exec will control.

The second parameter is the number punched on the REPTIME card, labeled EXEC 54. REPTIME should be set to the number of clock cycles from the start of one sequence to the next.

The first table to be filled is the INITLTIME table, which must contain N entries. The jth entry is the number of clock cycles after the start of the exec that the jth routine is to be executed.

[illegible]

The other required table is called JUMPTABLE. It also must contain N entries, each of which must be a return jump (RJP) to the desired routine. Each entry in the JUMPTABLE may be coded with a keyset condition.

THEORY OF OPERATION

Once initiated, the exec transfers the contents of INITLTIME to a working area, TIMETABLE, and waits for a command to start. When this is received, the real-time clock is zeroed and a comparison is made between the clock and the first entry in TIMETABLE. When the clock reaches or exceeds this value, the table value is increased by REPTIME and the new value is checked for overflow. The corresponding routine in JUMPTABLE is executed, provided that the keyset condition is met or the entry has not been cleared.

If the overflow test indicated that a reset of the clock was necessary, the clock reading is subtracted from all entries in TIMETABLE and the clock is zeroed.

A check is then made to determine whether the program should be terminated. If so, the exec exits. If not, the routine index is incremented by one and the exec awaits the execution time of the next routine. Following the execution of the last routine in the sequence, the routine index is cleared so that the exec now waits for the proper time to re-execute the first routine in the sequence.

METHODS OF DELETING A ROUTINE

There are two ways in which a routine can be deleted. The most flexible is by including a keyset condition in the coding of the JUMPTABLE. Thus the execution would be deleted if the keyset condition were not met.

Another method is to simply zero out the desired cell in JUMPTABLE. The exec performs a test on the entries prior to any attempted execution and aborts if a zero is found.

CHANGING THE TIMING

The execution time of any or all routines may be advanced or retarded by increasing or decreasing the contents of the associated TIMETABLE cell(s) by the desired number of clock cycles.

NUSL Tech Memo
No. 2211-63-70

GENERAL COMMENTS

The enclosed program listing is coded so that the exec may be started and terminated by either a key setting or the setting of a memory cell. The memory cell flag seems to be preferable since it can be set by interrupt from a keyboard or an external piece of equipment.

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APPENDIX A
PROGRAM LISTING

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TEST 01 C-CONTROL
TEST 02 ALLOCATION
TEST 03 BASE 10000
TEST 04 ENTRANCE GPEXEC1
TEST 05 SYS-PROC*POTIER*FEB70
TEST 06 LOC-DD
TEST 07 VRBL*TIME*FX**100
TEST 08 END-LOC-DD
TEST 09 PROCEDURE*R1
TEST 10 PUT*W(160)*W(TIME)
TEST 11 TYPET*$CR$ROUTINE
TEST 12 ENT*A*1+B1
TEST 13 TYPE-DEC*A*$SP*$SP$
TEST 14 TYPE$*TIME*THEN*RETURN
TEST 15 END-PROC*R1
TEST 16 PROCEDURE*R2
TEST 17 R1
TEST 18 RETURN
TEST 19 END-PROC*R2
TEST 20 PROCEDURE*R3
TEST 21 R1
TEST 22 RETURN
TEST 23 END-PROC*R3
TEST 24 PROCEDURE*R4
TEST 25 R1
TEST 26 TYPET*$CR$END OF CYCLE$CR$
TEST 27 RETURN
TEST 28 END-PROC*R4
EXEC 01 GPEXEC1 PROGRAM*USN/USL
EXEC 02 COMMENT*GENERAL PURPOSE REAL-TIME EXECUTIVE
EXEC 03 COMMENT*ROUTINE FOR UNIVAC 1230 COMPUTER
EXEC 04 CLOCK EQUALS*160
EXEC 05 N EQUALS*4*CHANGE FOR NUMBER OF ROUTINES
EXEC 06 COMMENT*N IS THE NUMBER OF ROUTINES TO BE
EXEC 07 COMMENT*CONTROLLED BY THE EXECUTIVE
EXEC 08 GPEXEC1 ENTRY
EXEC 09 STR*BO*W(STARTEND)*INITIALIZE CONTROL FLAG
EXEC 10 ENT*B7*N-1*INITIALIZE
EXEC 11 EXEC1 ENT*A*W(INITLTIME+B7)*TIMETABLE
EXEC 12 STR*A*W(TIMETABLE+B7)
EXEC 13 BJP*B7*EXEC1
EXEC 14 COMMENT*INSERT ADDITIONAL INITIALIZING
EXEC 15 COMMENT*ROUTINES HERE
EXEC 16 EXEC2 ENT*A*U(STARTEND)*ANOT*TIME TO START
EXEC 17 JP*EXEC2*KEY1*NO WAIT
EXEC 18 STR*BO*W(CLOCK)*YES CLEAR CLOCK
EXEC 19 CL*B1*SUBROUTINE INDEX
EXEC 20 EXEC3 ENT*Q*W(TIMETABLE+B1)*EXECUTION TIME
EXEC 21 EXEC4 ENT*Y*G*(CLOCK)*APOS*TIME TO EXECUTE
EXEC 22 JP*EXEC4*NO WAIT
EXEC 23 ENT*Q*W(REPTIME)*YES
EXEC 24 RPL*Y*G*(TIMETABLE+B1)*UPDATE TABLE
EXEC 25 STR*BO*W(CLOCKFLAG)*CLEAR RESET FLAG
EXEC 26 LSH*A*1*APOS*TEST FOR CLOCK RESET
EXEC 27 STR*BO*CP*(CLOCKFLAG)*RESET NEEDED
EXEC 28 STR*B1*L(EXEC6)*SAVE INDEX
EXEC 29 ENT*A*W(JUMPTABLE+B1)
EXEC 30 STR*A*W(EXEC5)*AZERO*ROUTINE DELETED

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EXEC 31 EXEC5 0'NO EXECUTE IT
EXEC 32 EXEC6 ENT*B1*0'RESTORE INDEX
EXEC 33 ENT*A*W(CLOCKFLAG)'RESET CLOCK
EXEC 34 JP*EXEC7*AZERO'NO
EXEC 35 ENT*G*W(CLOCK)'YES
EXEC 36 RPT*N*ADV'ADJUST
EXEC 37 RPL*Y-G*W(TIMETABLE)'TABLE
EXEC 38 STR*B0*W(CLOCK)'CLEAR CLOCK
EXEC 39 EXEC7 BSK*B0*L(STARTEND)'TERMINATE PROGRAM
EXEC 40 EXIT'YES
EXEC 41 EXIT*KEY2'YES IF KEY2 SET
EXEC 42 BSK*B1*N-1'NO INCREMENT INDEX
EXEC 43 NO-OP
EXEC 44 JP*EXEC3
EXEC 45 INITLTIME 2048D'T1 - 2 SECONDS
EXEC 46 12800D'T2 - 12.5 SECONDS
EXEC 47 25856D'T3 - 25.25 SECONDS
EXEC 48 40832D'T4 - 39.675 SECONDS
EXEC 49 TIMETABLE RESERVE*N'NUMBER OF ROUTINES
EXEC 50 JUMPTABLE RJP*R1
EXEC 51 RJP*R2*KEY3
EXEC 52 RJP*R3
EXEC 53 RJP*R4
EXEC 54 REPTIME 102400D'TIME BETWEEN RECYCLES 100 SECONDS HERE
EXEC 55 CLOCKFLAG 0'CLOCK RESET FLAG
EXEC 56 STARTEND 0'UPPER START,LOWER END
END-DATA

```

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APPENDIX B
TIMING AND FLOW CHARTS

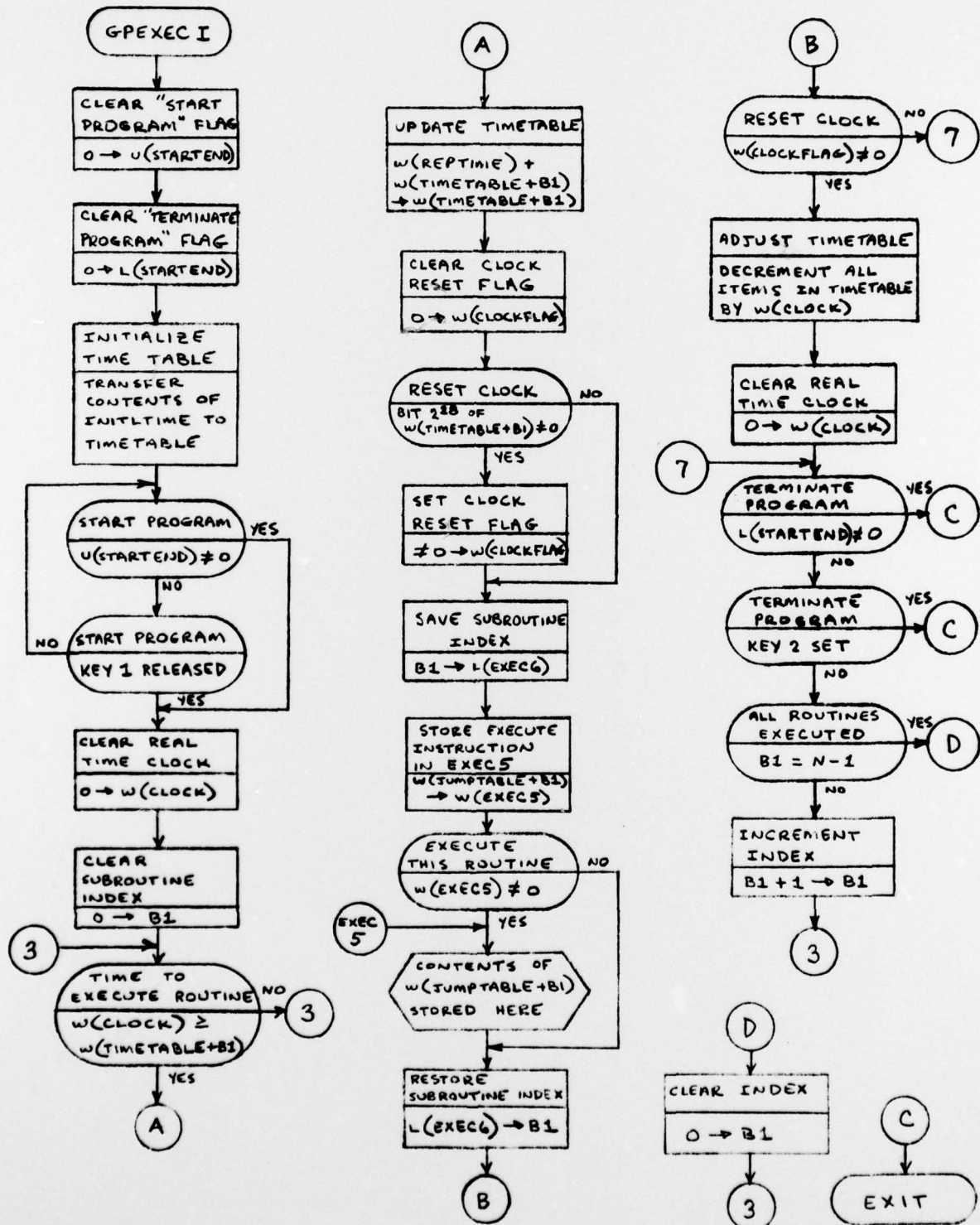
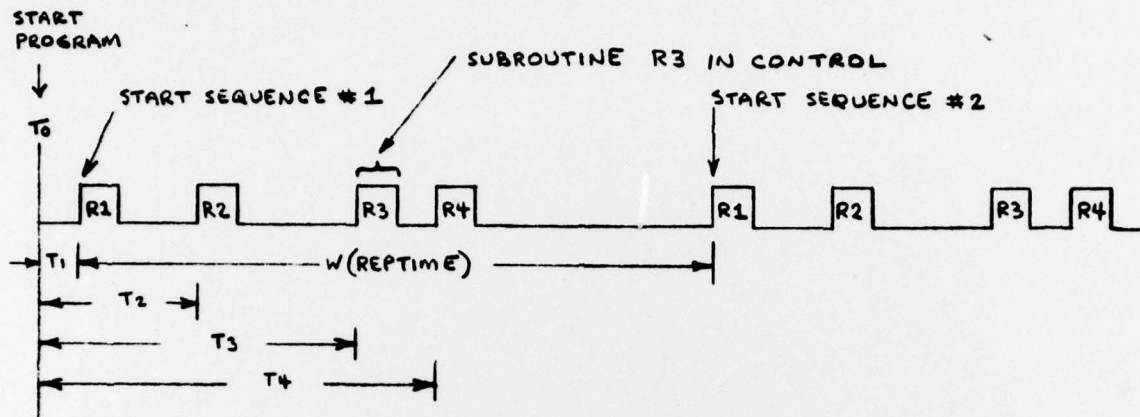


FIGURE 1 - DETAILED FLOWCHART OF GPEXEC I



INITLTIME
T ₁
T ₂
T ₃
T ₄

TIMETABLE
T ₁
T ₂
T ₃
T ₄

BEFORE
SEQUENCE #1

TIMETABLE
T ₁ +w(REPTIME)
T ₂ +w(REPTIME)
T ₃ +w(REPTIME)
T ₄ +w(REPTIME)

AFTER
SEQUENCE #1

JUMPTABLE
RJP * R1
RJP * R2 * KEY3
RJP * R3
RJP * R4

NOTES

1. THE ENTIRE SEQUENCE OF SUBROUTINES MAY BE SHIFTED EARLIER/LATER IN TIME BY DECREMENTING/INCREMENTING ALL ITEMS IN TIMETABLE BY Δt .
2. INDIVIDUAL SUBROUTINES MAY BE SHIFTED EARLIER/LATER IN TIME BY DECREMENTING/INCREMENTING THE CORRESPONDING ITEM IN TIMETABLE BY Δt .
3. SUBROUTINE R2 WILL BE EXECUTED ONLY IF KEY 3 IS SET.
4. INDIVIDUAL SUBROUTINES MAY BE DELETED BY STORING A ZERO IN THE CORRESPONDING ITEM IN JUMPTABLE.

FIGURE 2 - SAMPLE TIMING CHART AND CONTENTS OF EXEC TABLES